Emerging Fluoroquinolone Resistance among Non-Typhoidal *Salmonella* in the United States: NARMS 1996-2000

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Background: Fluoroquinolones (e.g., ciprofloxacin) commonly are used for treating Salmonella infections in adults; fluoroquinolones (e.g. enrofloxacin) also are used in cattle, chickens, and turkeys in the United States. Among *Salmonella*, cross-resistance occurs for all fluoroquinolones and usually arises from accumulation of two mutations in the *gyrA* gene. A single mutation of the *gyrA* gene confers decreased susceptibility to fluoroquinolones and has been associated with treatment failures.

Methods: The National Antimicrobial Resistance Monitoring System (NARMS) for Enteric Bacteria was established in 1996 to monitor antimicrobial resistance in *Salmonella* and other enteric bacteria. After serotyping, public health laboratories in the 17 NARMS participating sites forwarded every tenth non-typhoidal *Salmonella* isolate to CDC for susceptibility testing to ciprofloxacin and 16 other antimicrobial agents using broth microdilution (Sensititre) according to NCCLS standards. Patients with isolates exhibiting decreased susceptibility (MIC > 0.25 µg/ml) to ciprofloxacin, including ciprofloxacin resistance (MIC > 4 µg/ml), were interviewed.

Results: From 1996-2000, 57 (0.8%) of 6970 non-typhoidal *Salmonella* isolates tested demonstrated decreased susceptibility to ciprofloxacin. The percent of isolates that demonstrate decreased susceptibility to fluoroquinolones was 0.4% (5/1326) in 1996 and 1.4% (20/1378) in 2000. Seven (0.1%) of these isolates were ciprofloxacin-resistant (MIC >= 4 µg/ml) and included serotype Senftenberg (n=3), Schwarzengrund (n = 3), and Indiana (n = 1). All 7 infections were associated with international travel. Of the 50 isolates with ciprofloxacin MICs > 0.25 µg/ml and < 4 µg/ml, the most common serotypes were Enteritidis (n = 14), Berta (n = 7), Typhimurium (n = 6), and Virchow (n = 5). Twenty-eight (56%) of these 50 patients were interviewed; 20 (71%) of the 28 patients interviewed did not travel internationally in the week before illness onset.

Conclusion: Emerging fluoroquinolone resistance in non-typhoidal *Salmonella* is evident. Resistant isolates were associated with international travel, whereas other isolates with decreased susceptibility were from infections acquired domestically. The sources of infection were not investigated, but many presumably were acquired through eating contaminated food. Mitigation efforts in partnership with the agricultural and veterinary communities are needed to limit use of fluoroquinolones and to preserve the efficacy of this commonly used antimicrobial agent.

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